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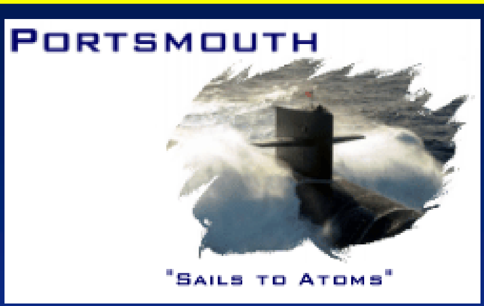
US Army Corps
of Engineers
Omaha District



Innovative Design Concepts Incorporated into a Landfill Closure and Reuse Design Portsmouth Naval Shipyard, Kittery, Maine

U.S. Army Corps of Engineers, Omaha District
Dave Ray
Kevin Pavlik

Presentation Outline

- Background
- Pre-Design Requirements/Investigation
- Design
- Shoreline Protection
- Landfill Gas
- Final Reuse
- Questions

Project Team

Naval Facilities Engineering Command
Engineering Field Activity NorthEast

US EPA Region 1
Maine DEP
Restoration Advisory Board
NOAA, USFWS, Coastal Zone Mgmt

Portsmouth Naval Shipyard

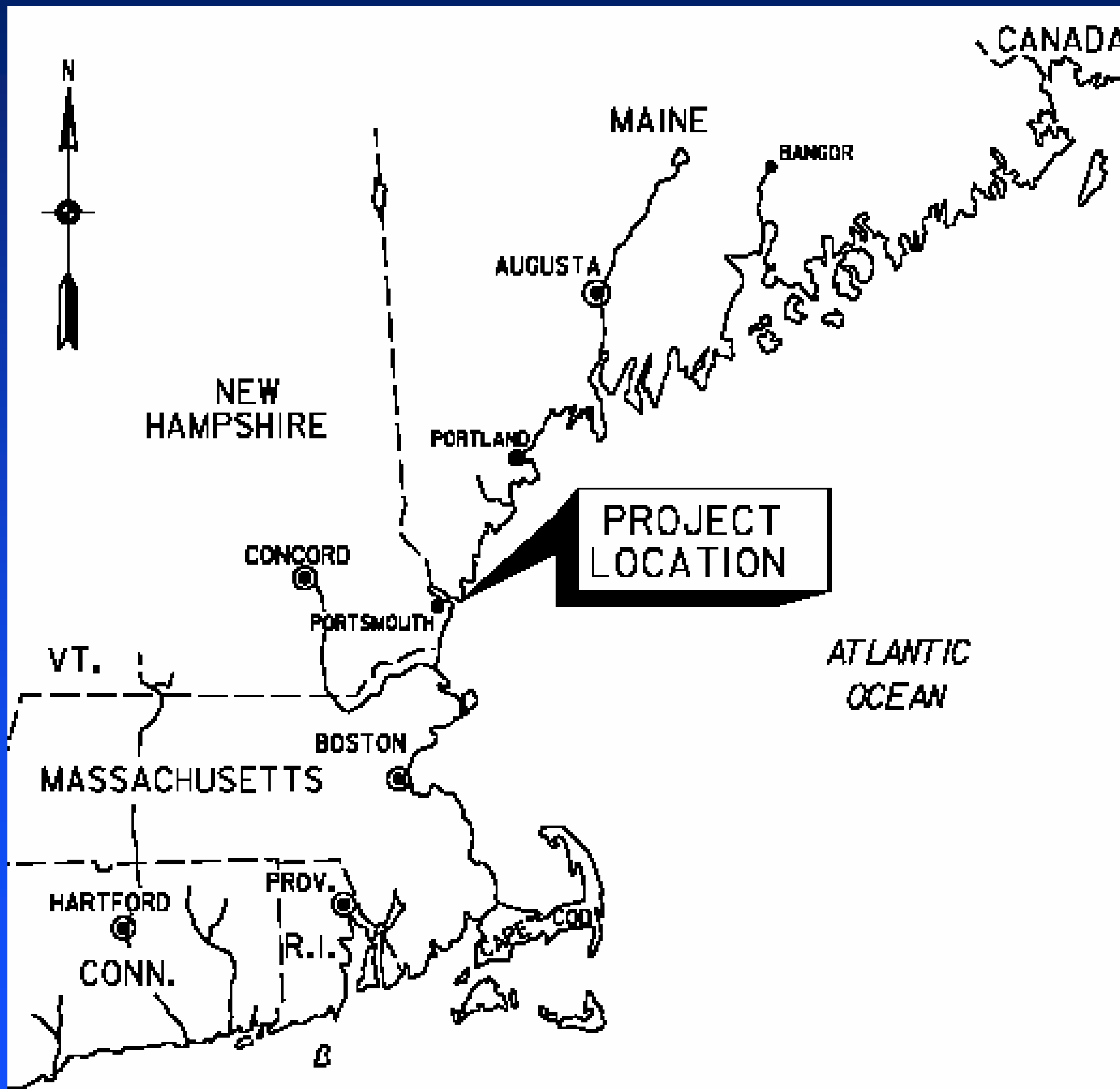
Tetra Tech NUS

Army Corps of Engineers
Omaha and New England Districts
EFANE Landscape Architect

Foster Wheeler
Environmental Corp.

Jamaica Island

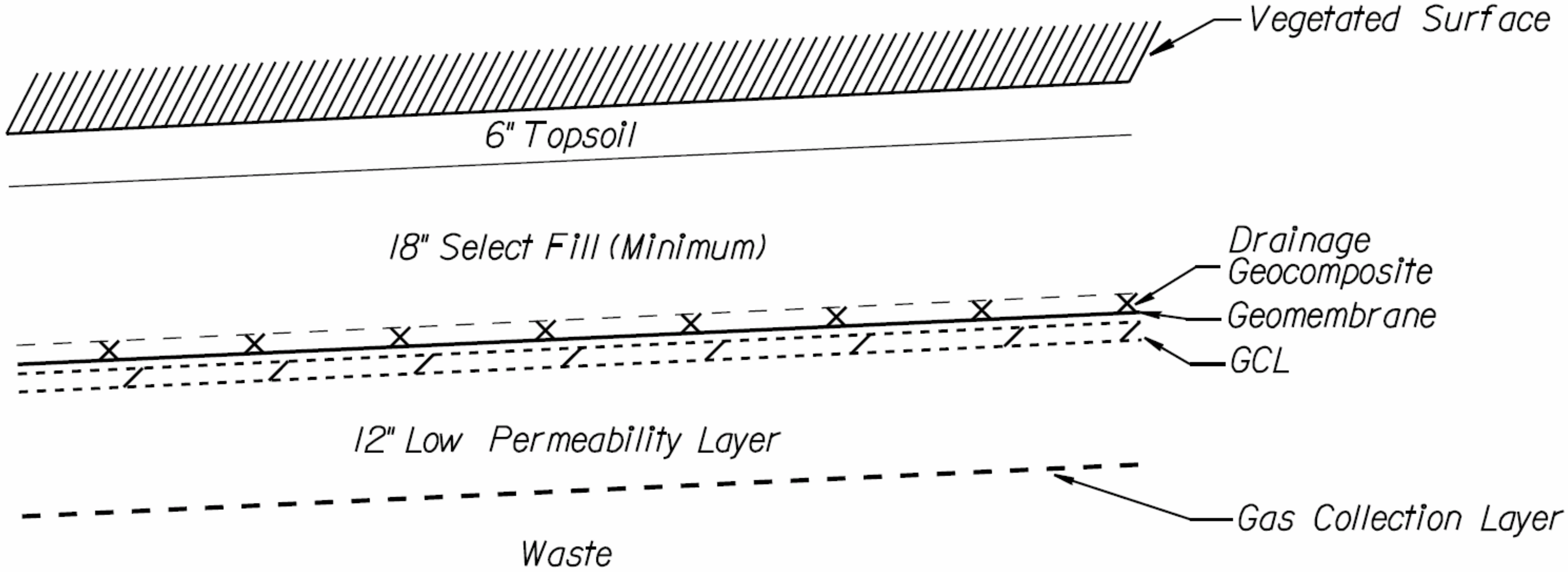
Installation Location



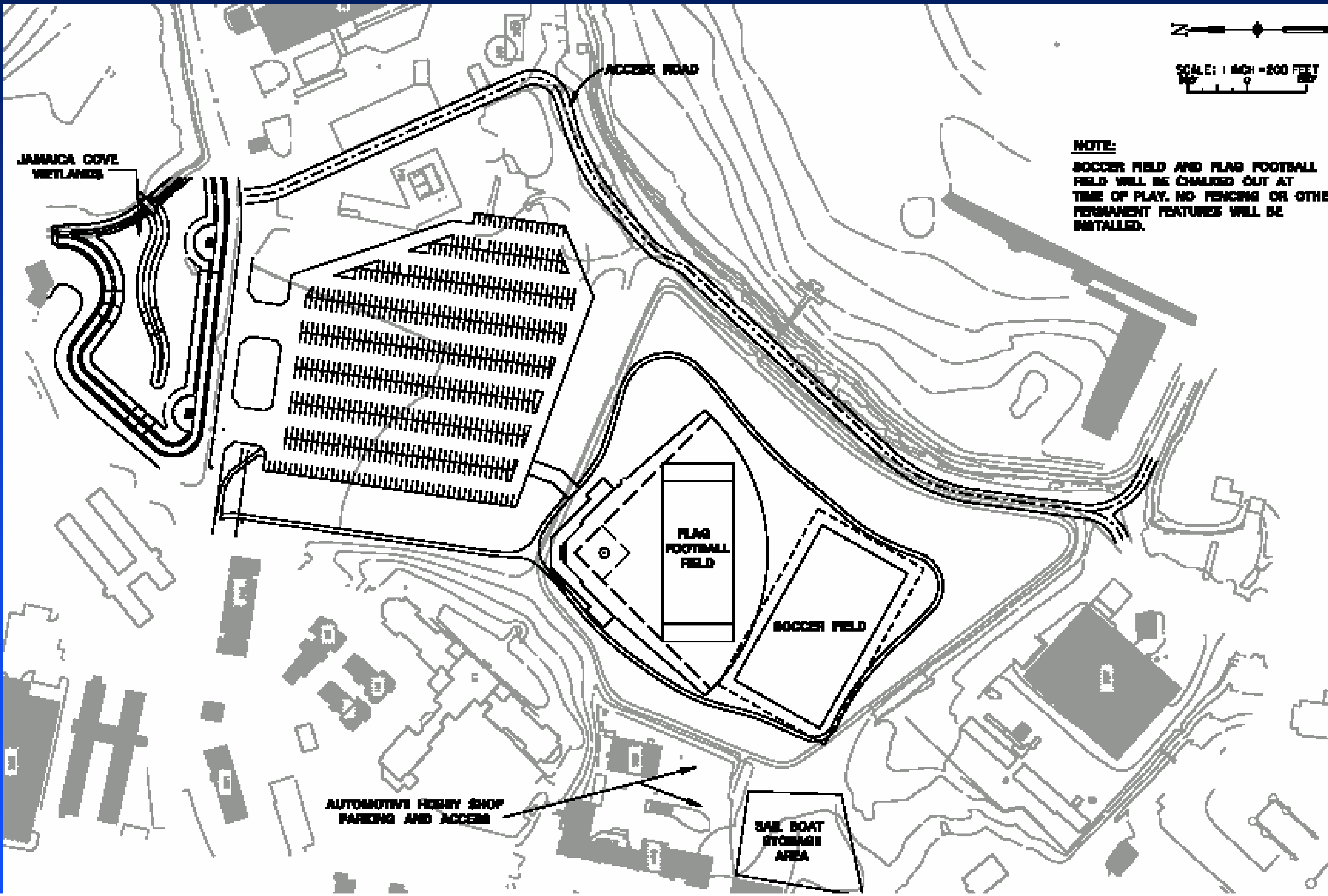
Pre-Jamaica Island Landfill

Pre-Remedy Uses/Pre-Excavation

RCRA Level C Hazardous Waste Landfill Cover or Equivalent



Final Reuse


ACCESS ROAD
JAMAICA COVE WETLANDS
NOTE:
SOCCER FIELD AND FLAG FOOTBALL FIELD WILL BE CHALKED OUT AT TIME OF PLAY. NO FENCING OR OTHER PERMANENT FEATURES WILL BE INSTALLED.
FLAG FOOTBALL FIELD
SOCCER FIELD
AUTOMOTIVE HOBBY SHOP PARKING AND ACCESS
SAIL BOAT STORAGE AREA

Design Challenges

- Final Reuse
  - Surface slopes to support recreation areas
  - Internal drainage slopes to meet regulatory requirements
- Minimize material export and import
  - Use maintenance dredge spoils below cover
  - Saw tooth internal drainage layer
- Minimize settlement
  - Preload
- Tide varies 10 feet

Regulatory Concerns

- 2% Minimum Surface Slope
  - EPA 3%, MEDEP 5%
  - Settlement
- Cap Cross Section
- Soil Gas Management
- Sea Level Rise
- Wetland Creation
- Aesthetics (View from the river and shore)

Design Goals

- Protect the Environment
  - Implement ROD
  - Meet Regulatory Requirements
- Reuse
  - Create Wetlands and Incorporate Maintenance Dredge Materials
  - Incorporate Recreation and Parking
  - Relocate crane test pad
- Cost
  - Minimize Construction and Long Term O & M
- Minimize Impacts to Base Operations
- Complete in Two Phases
  - Time and Seasonal Constraints

Innovative Features

- CPT for waste & subsurface characterization
- Wetland creation
- Coastal tie-in
- Use of geotextile in LFG collection layer
- Maintenance dredge spoils reuse
- Saw tooth design of internal drainage layer
- Final reuse

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Pre-Design Requirements

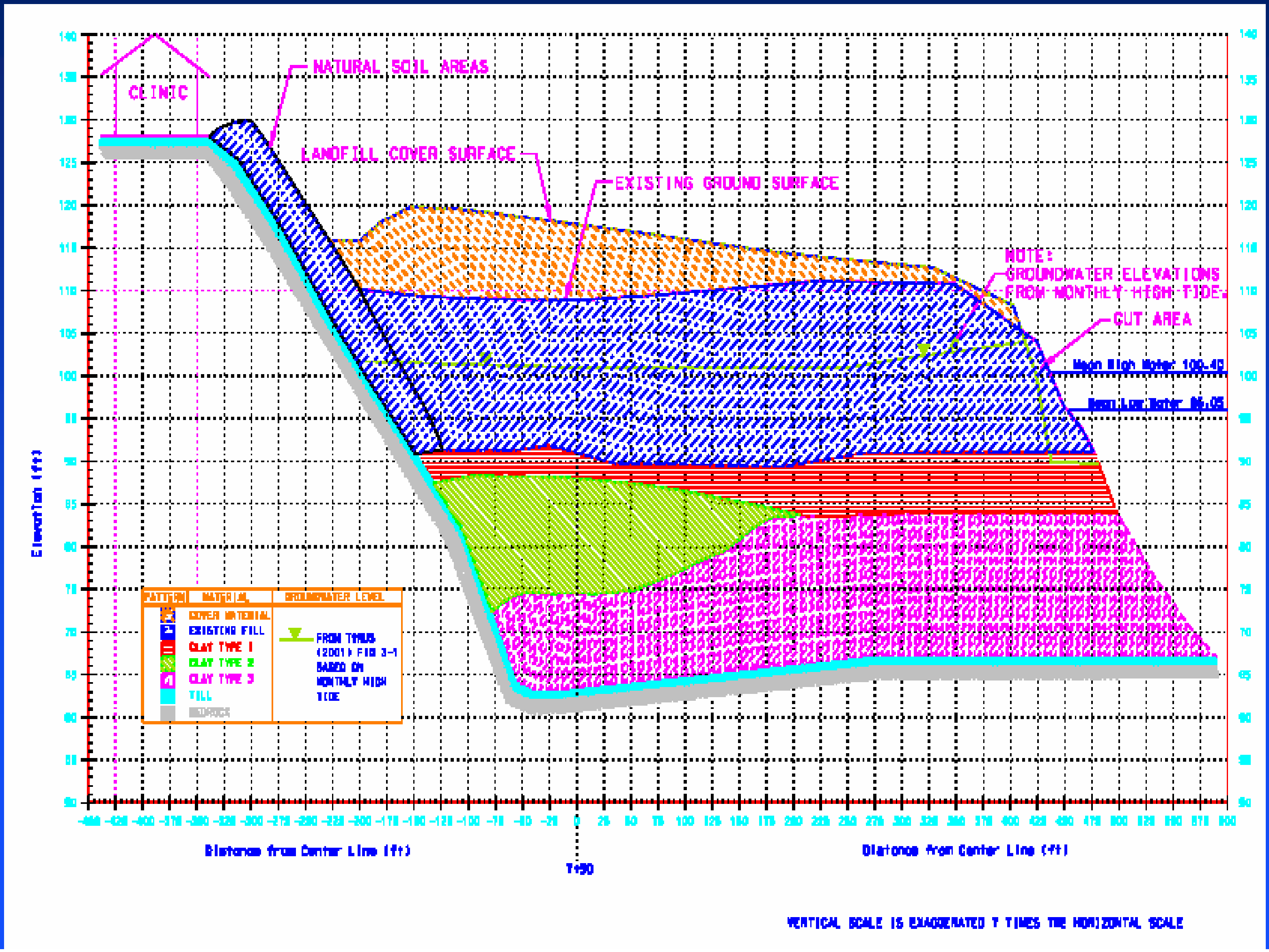
- Site Topographic Survey
  - Aerial photography
  - Hydrographic (Clark Cove and Jamaica Cove)
  - Land survey to "ground truth" and locate utilities
- Cone Penetration Testing (CPT)
  - Vertical and areal extent of waste
  - Characterize layers (waste and soils; strength, consolidation)
- Borings
  - Undisturbed samples for Lab Testing: strength, consolidation (rate and magnitude), density, classification.
  - Standard Penetration Tests (SPT) to corroborate CPT
  - Bedrock competency (Rock Quality Designation, RQD)

Pre-Design Requirements

- Test Pits
  - Lateral and vertical extent of waste at undefined edges
- Landfill Gas Survey
  - Depth, location, and production rate (flux) of CH_4 and CO_2
- Piezometers
  - Determine extent of tidally influenced groundwater
  - Slope stability affected by excess pore pressures, shallow and deep piezometers installed to measure
  - Forced movement of air and landfill gas a concern
- Surface Soil Samples
  - Geotechnical testing for reuse in low permeability layer

Cone Penetrometer

Typical Geologic Cross Section



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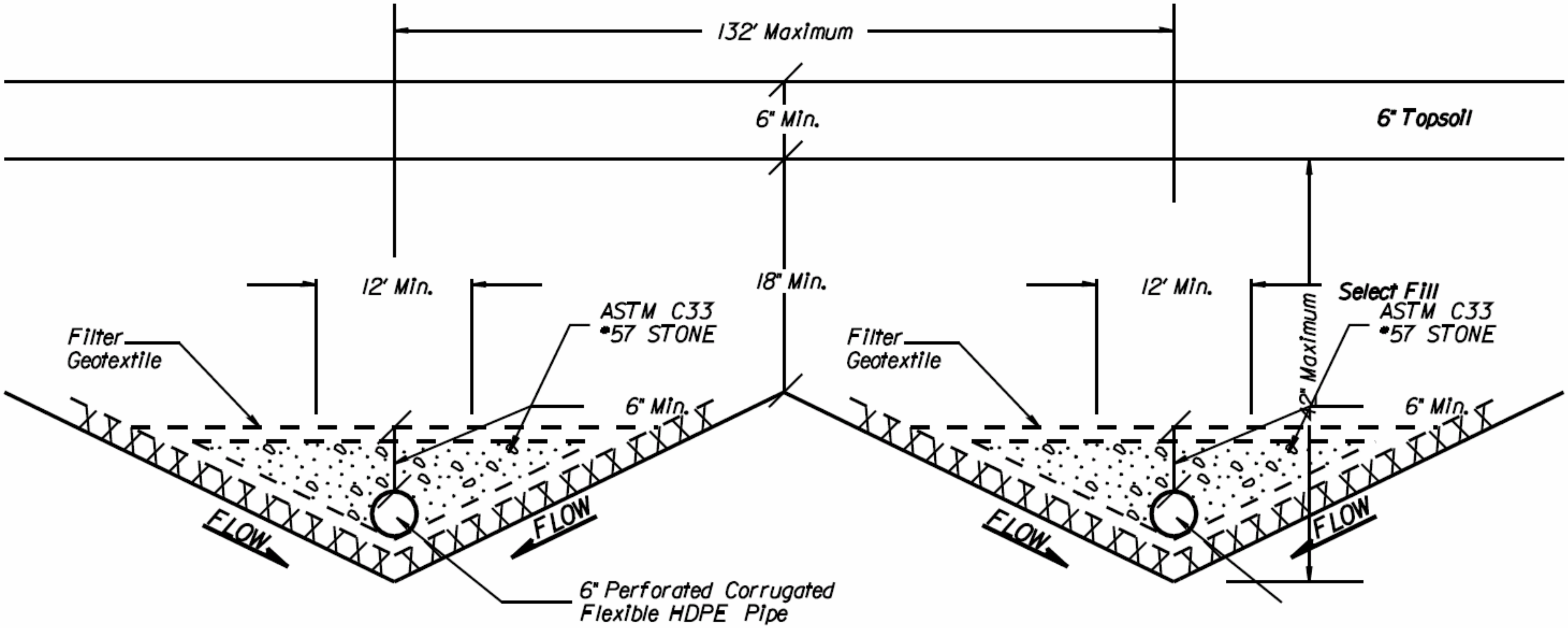
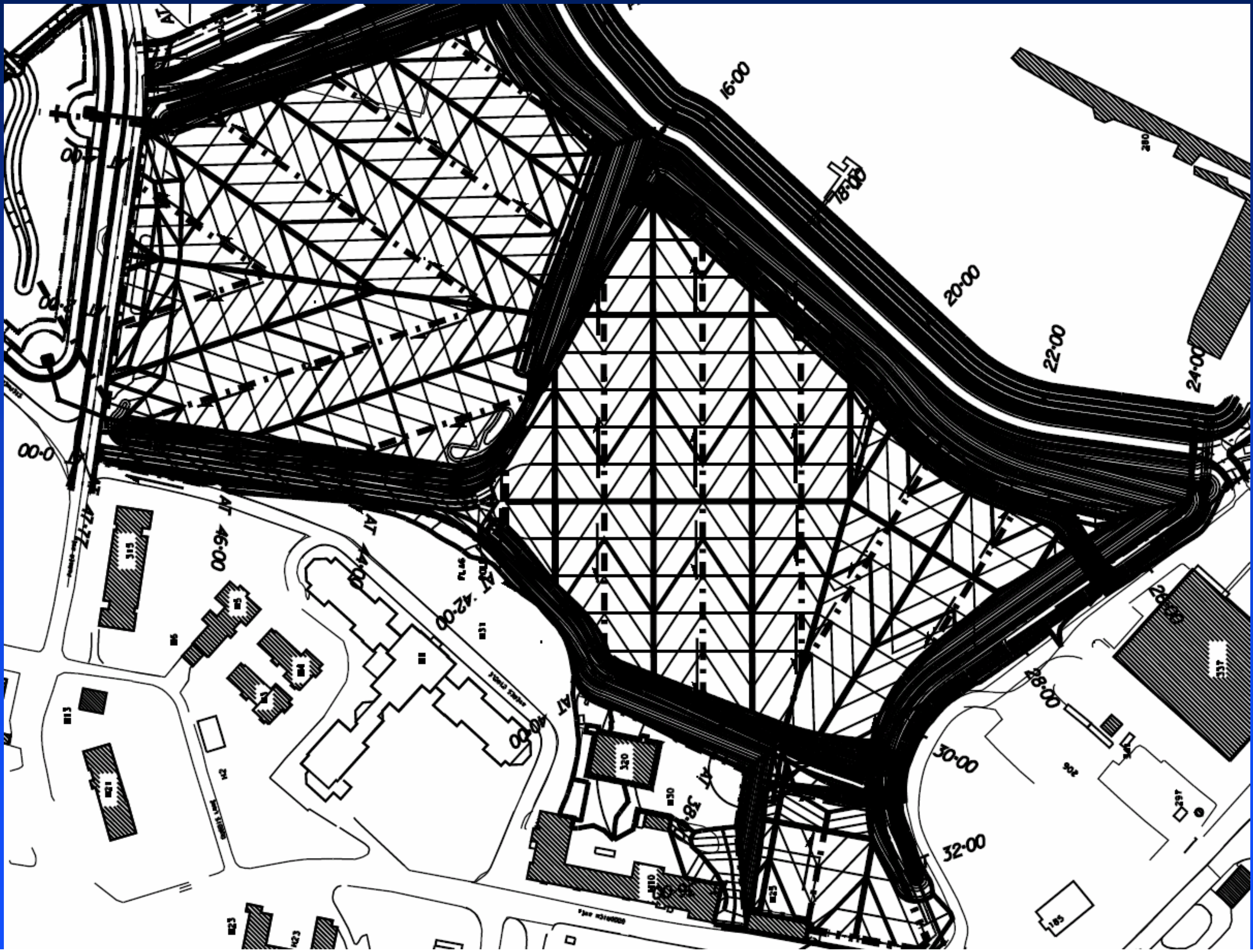
Design Analyses

- Settlement Analysis
  - Key to reuse and final slope (2% vs 5%)
  - Non-municipal type waste therefore traditional geotechnical settlement analysis was used
  - Consolidation rates:
    - Lab results for clay, CPT and literature for waste
  - 34 points
    - Stratigraphy based on CPT/Borings
    - Loading based on final grading plan (depth of fill)
    - Preload w/excavated material to reduce post construction settlement
  - Results

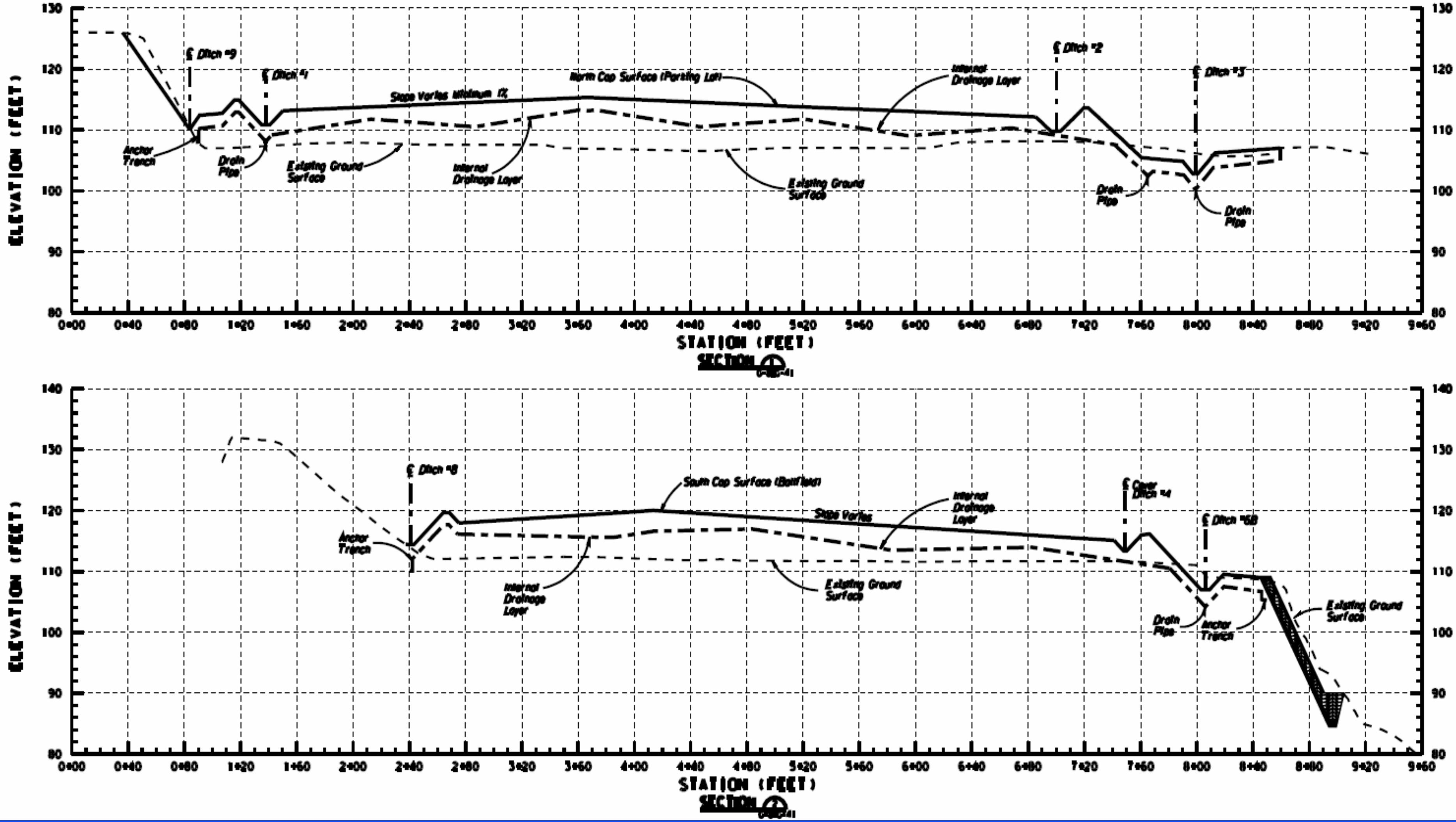
Typical Internal Drainage System Detail



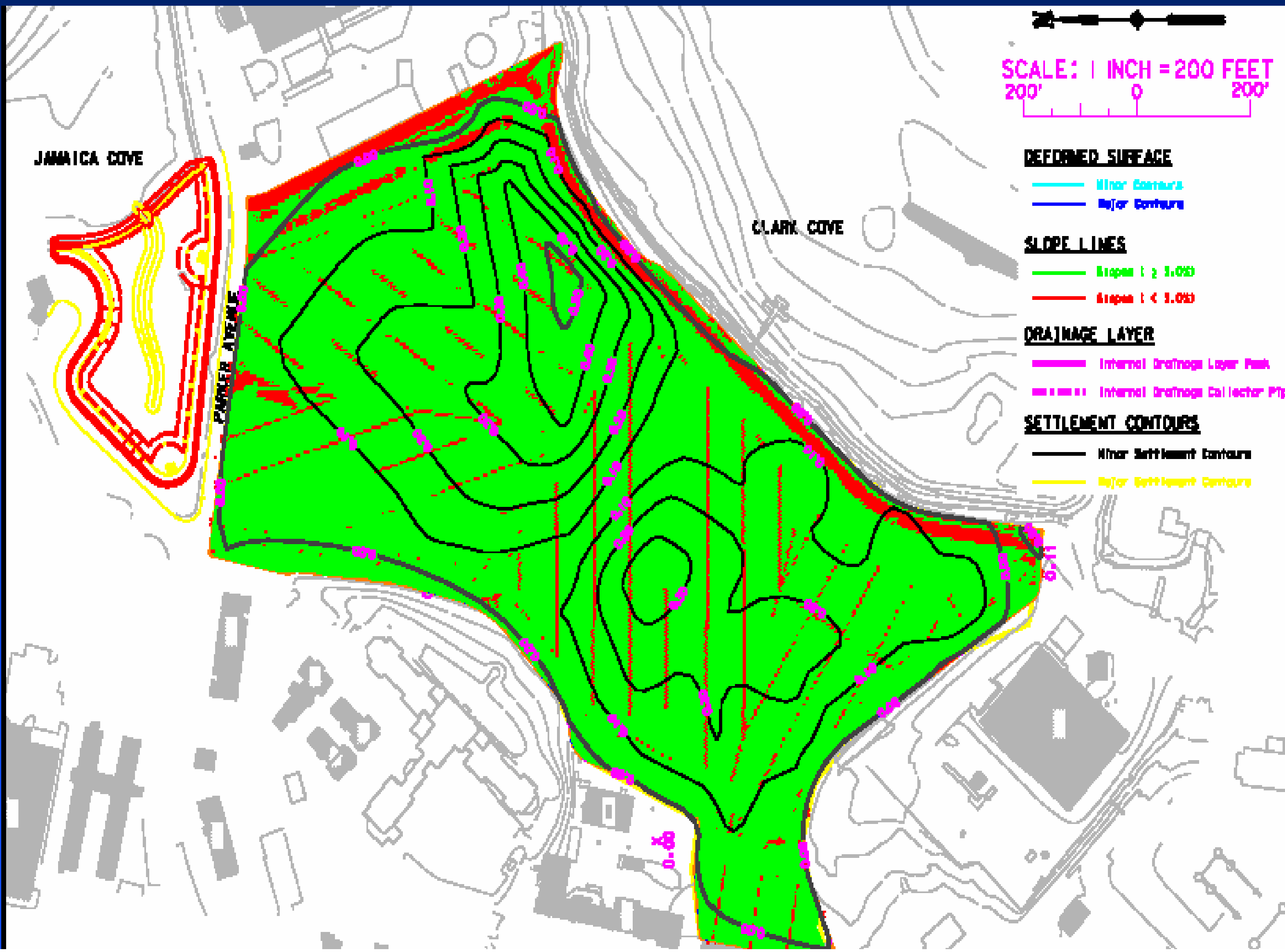
Internal Drainage Layer Plan



Typical Cross Sections



Post-Settlement Slope Analysis



Design Analyses

- Slope Stability
  - Geometry determined by geology, topography, and grading plan
    - Potential failure surfaces apparent from geometry and strength of layers
  - Loading
    - Weight of added material for landfill cover
    - Seismic forces
    - Rapid drawdown of water.
      - Tidal fluctuation similar rapid drawdown of liquid impoundment
  - Strength parameters from CPT, SPT, lab data, literature
    - Unconsolidated Undrained – controls short term strength
    - Consolidated Drained – controls long term strength

Design Analyses

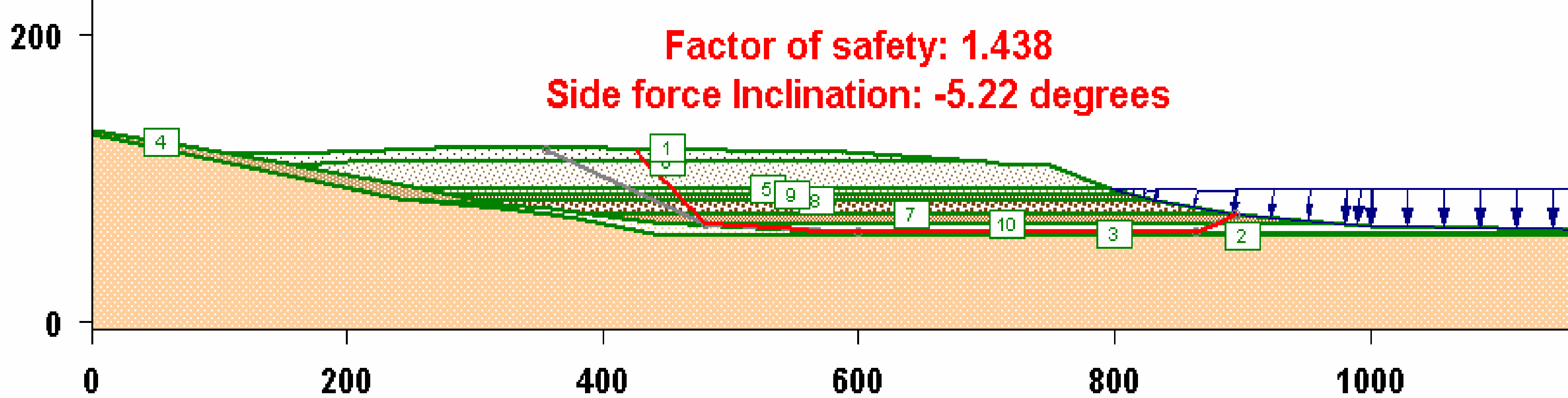
- Slope Stability
  - Piezometric Conditions
    - Modeled as worst case, no dissipation of excess pore pressure within clay.
  - Factors of Safety (FS)
    - RCRA Subtitle C
      - Short term static minimum FS = 1.3
      - Long term static minimum FS = 1.5
      - Seismic minimum FS = 1.0
    - MEDEP
      - Seismic minimum FS = 1.0 for 10% exceedance in 250 years
      - Seismic minimum FS = 1.1 for 10% exceedance in 50 years
  - Results
    - Minimum Factors of Safety met for all conditions

Design Analyses

- Slope Stability Analysis Methods
  - Global Stability
    - UTEXAS4 (USACE and U of Texas)
      - Searches for weakest possible failure surface
      - Multiple analysis methods available within program
    - WESHAKE5 (U of Cal-Berkley) used to determine the maximum horizontal acceleration
  - Seismic/Liquefaction potential determined not a problem

Seismic Slope Stability Analysis

NO.	DESCRIPTION	UNIT WEIGHT	SHEAR STRENGTH	PORE PRESSURE
1	Dredged Material	120	Cohesion: 1000.0 Friction angle: 0	None
2	Bedrock	150	Very Strong	Not Applicable
3	Till	135	Very Strong	Not Applicable
4	Existing Soil	120	Very Strong	Not Applicable
5	Clay 1 Top	120	Cohesion: 340.0 Friction angle: 0	None
6	Existing Waste/Fill	120	Cohesion: 0.0 Friction angle: 36	Piezometric Line no. 1
7	Clay 3 Top	120	Cohesion: 540.0 Friction angle: 0	None
8	Clay 2	120	Cohesion: 1400.0 Friction angle: 0	None
9	Clay 1 Bottom	120	Cohesion: 340.0 Friction angle: 0	None
10	Clay 3 Bottom	120	Cohesion: 600.0 Friction angle: 0	None



Design Analyses

- Slope Stability
  - Veneer Stability
    - Saturation of cover soil due to capacity of drainage layer
    - Analysis supports use of bi-planar vs tri-planar (except on side-slopes)
    - Interface friction
    - Slope geometry
    - Method of analysis
      - Geosynthetic Research Institute – GRI Report No. 18, "Cover Soil Slope Stability Involving Geosynthetic Interfaces
      - Geosynthetic Research Institute – GRI Report No. 19, "Design of Drainage Systems Over Geosynthetically Lined Slopes

Design Analyses

- Slope Stability
  - Veneer Stability (cont.)
    - Rate of precipitation
    - Soil layers; density, strength, permeability
    - Drainage layer transmissivity
      - Size drainage layer to minimize saturation of cover soil
    - Interface friction values
      - Textured geomembrane has higher friction value
      - Add geotextile to surface of drainage layer to increase friction
    - Transmissivity vs length of drainage path
    - Factors of safety
      - Static, minimum FS = 1.5
      - Seismic, minimum FS = 1.0

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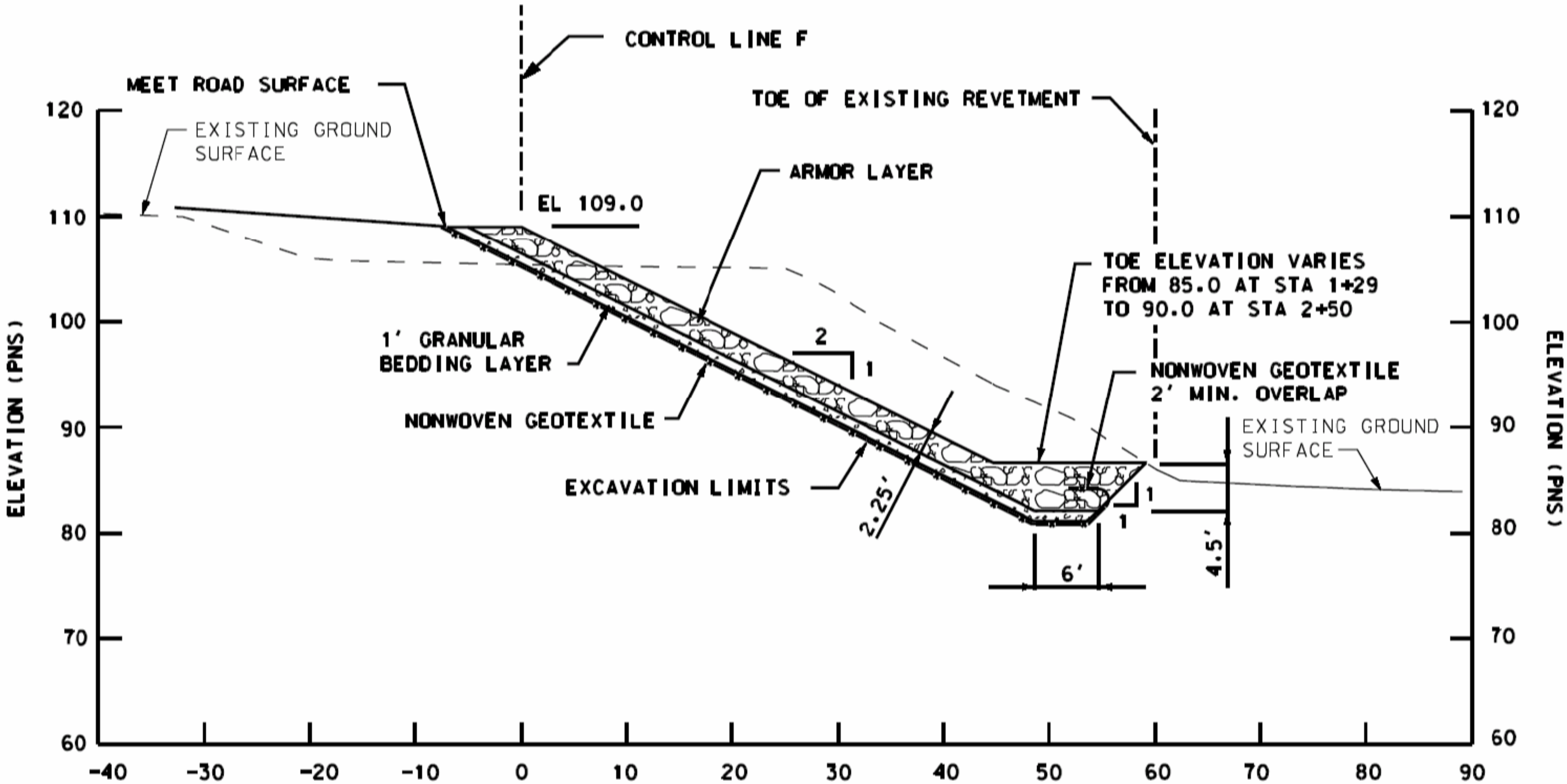
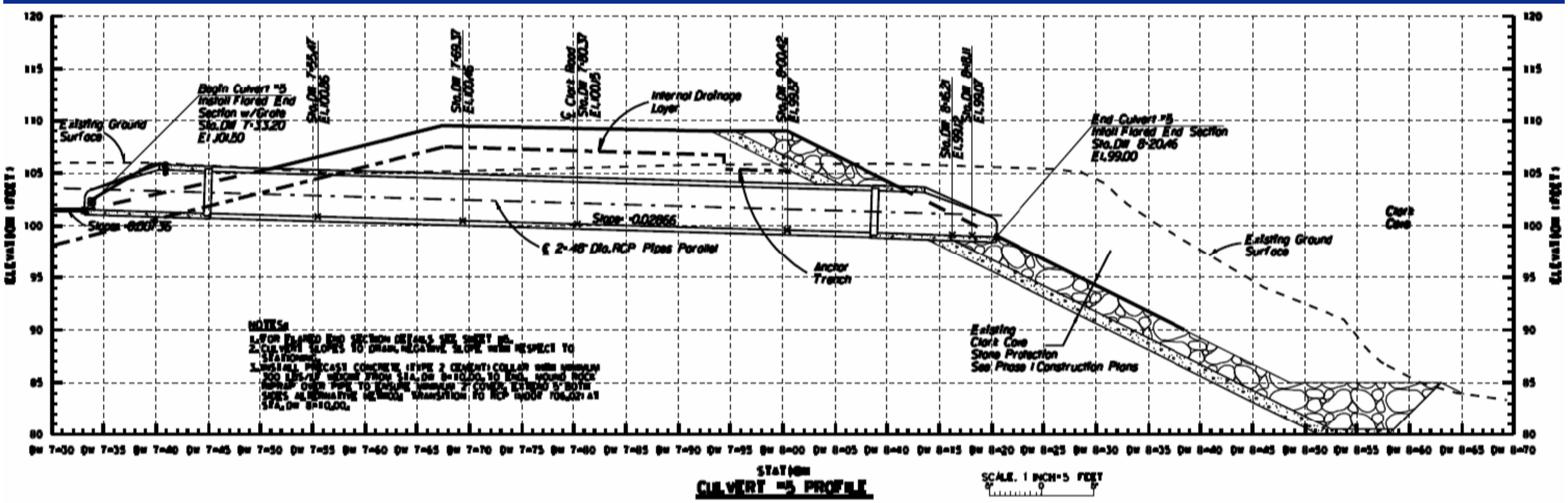
Typical Shoreline Protection Section



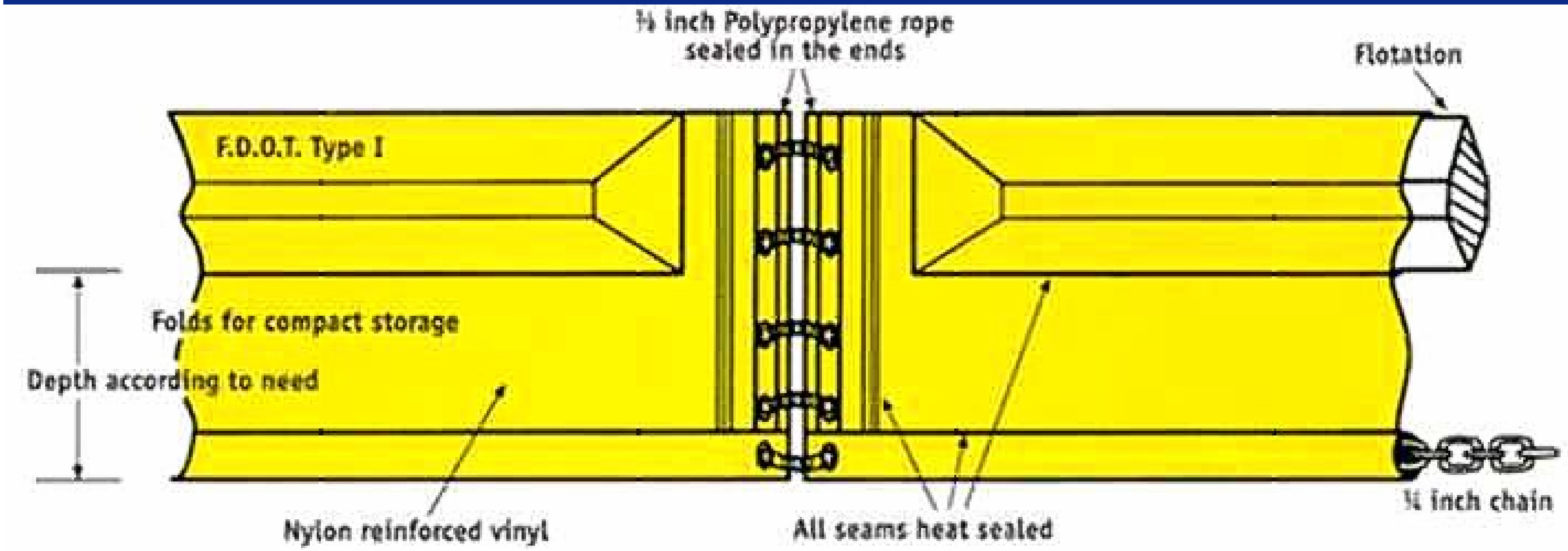
Typical Culvert Profile



Shoreline Protection

Turbidity Curtain

Turbidity Curtain



Shoreline Protection and Geomembrane Termination

Presentation Outline

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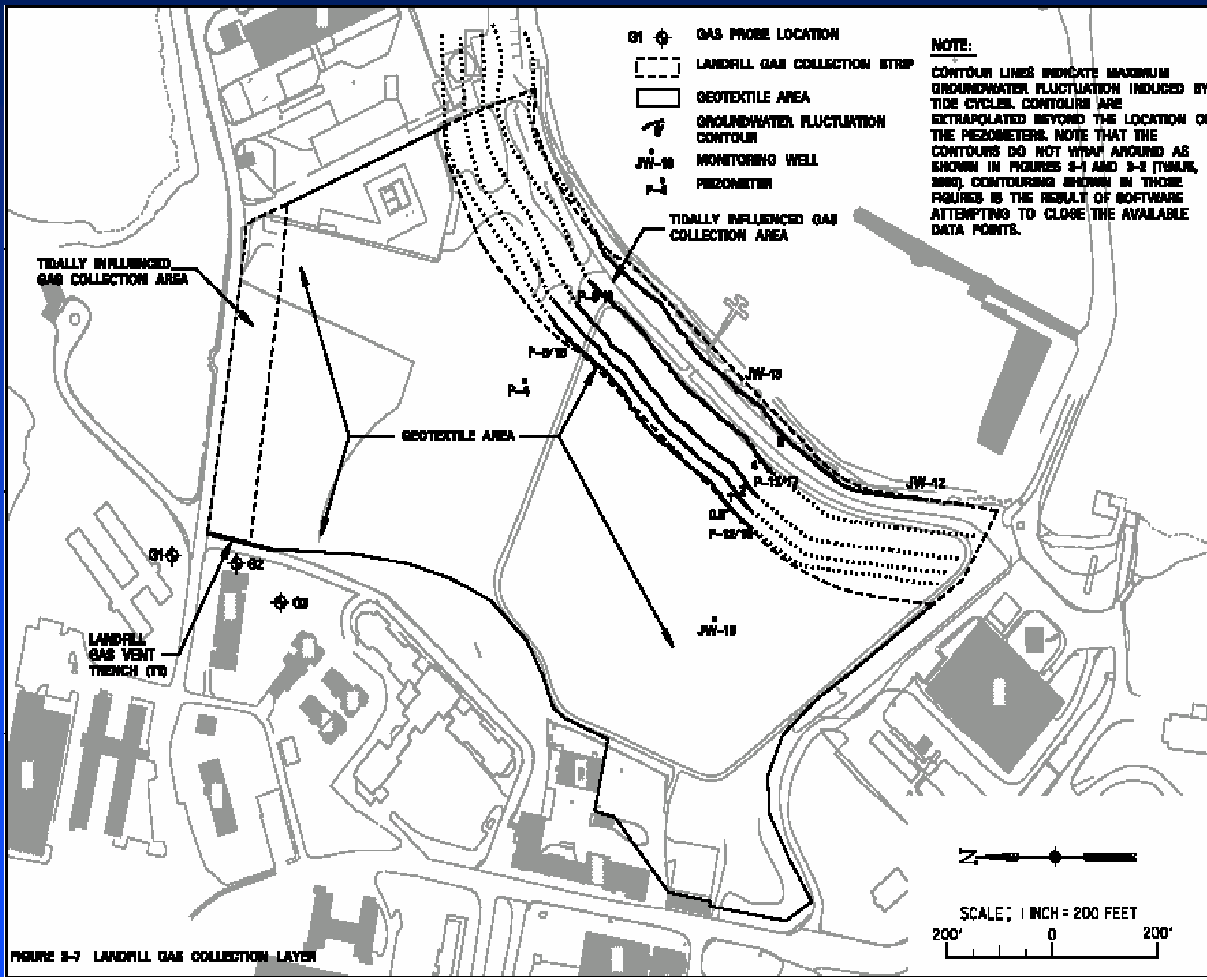
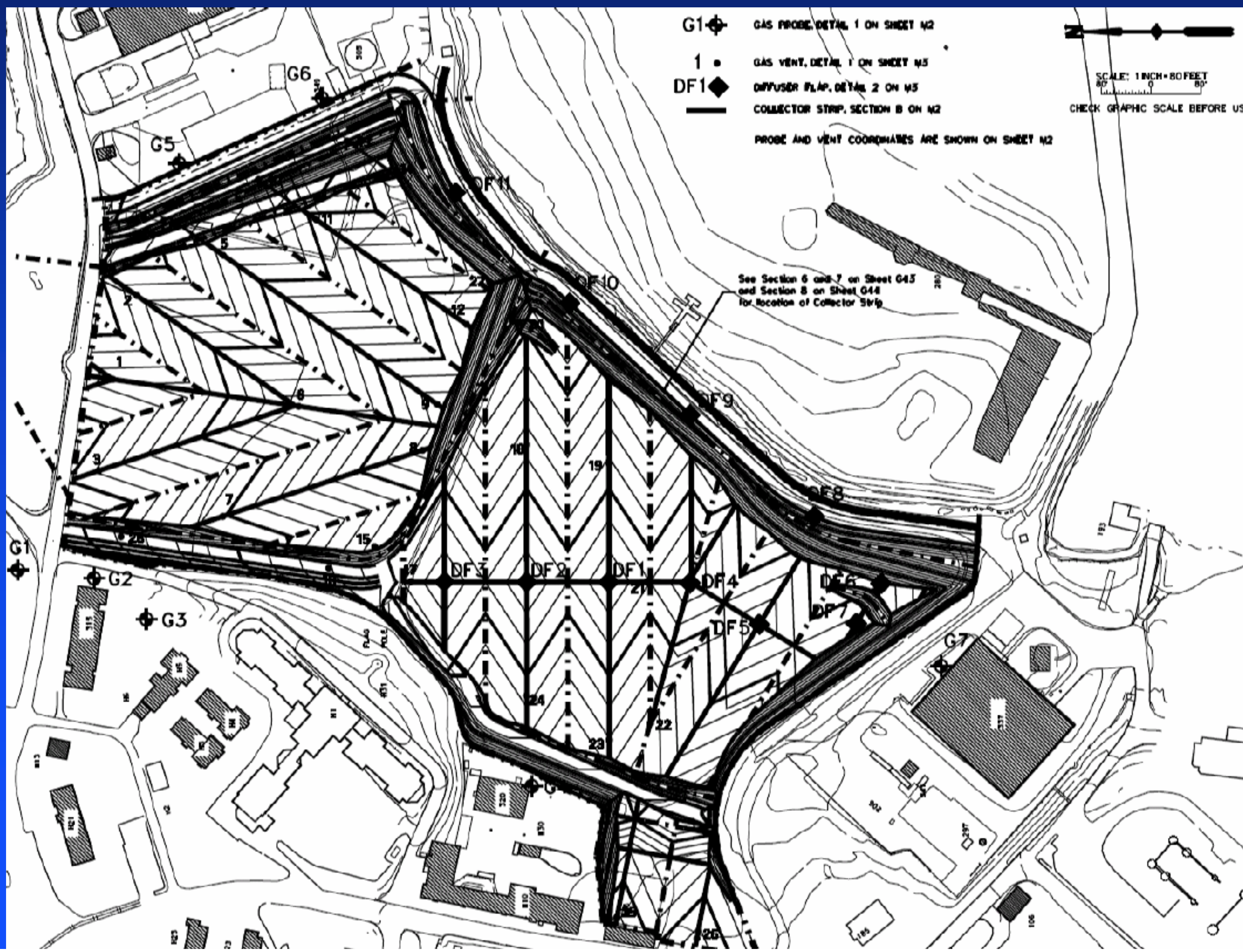
LFG Collection and Venting

- Prevent build-up and lateral migration of methane
  - Build-up beneath geomembrane can cause slope instability
- Passive vs Active collection system
  - Age and composition of waste, climate and moisture condition of waste
- Passive blanket collection system
  - Sized for measured methane production rate and calculated tidally induced gas movement
  - Geotextile used with collector strips and vents spaced based on transmissivity of layer. Maximum gas pressure determined by slope stability (thickness of overburden vs gas pressure)

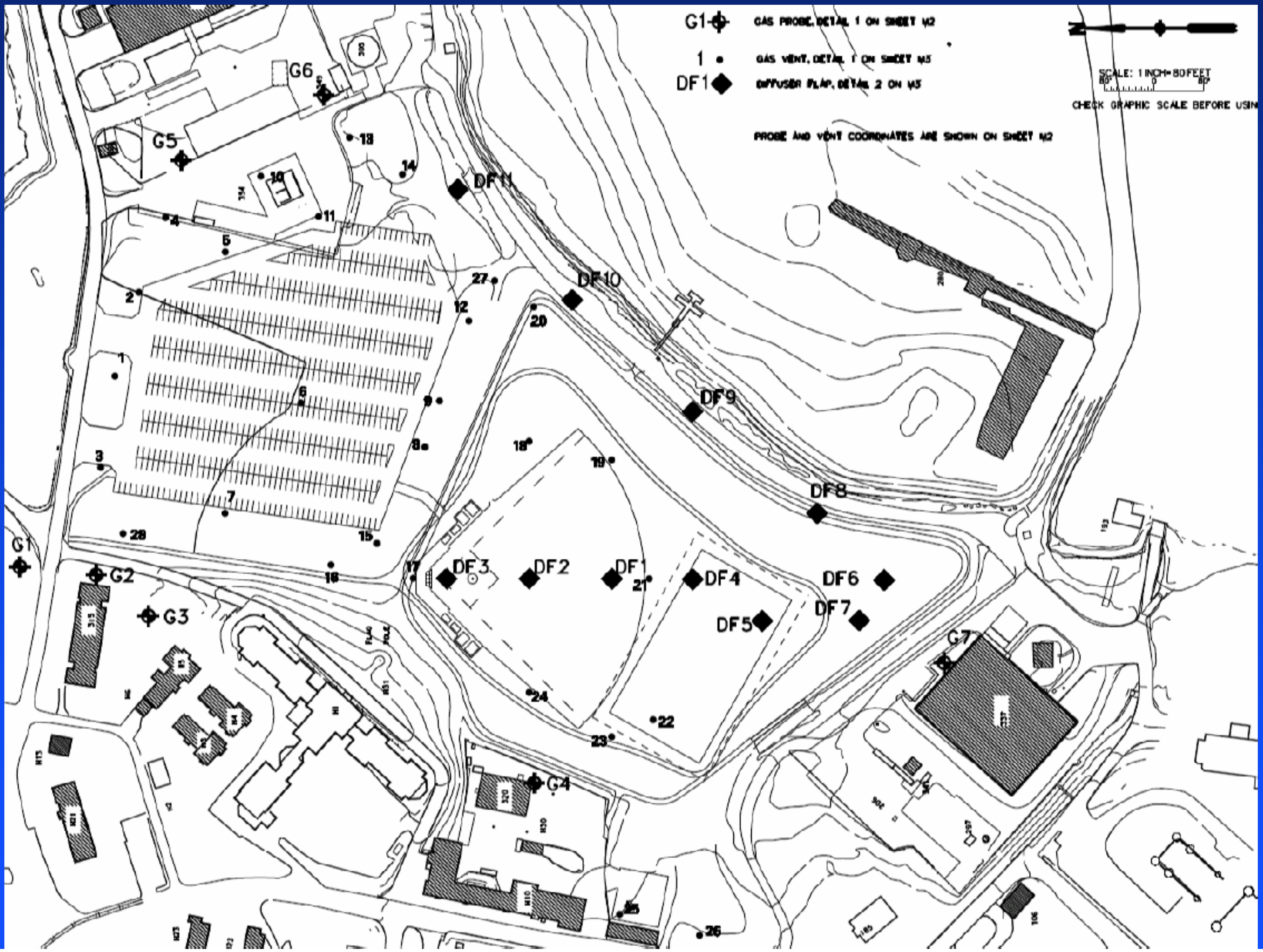
LFG Collection Layer



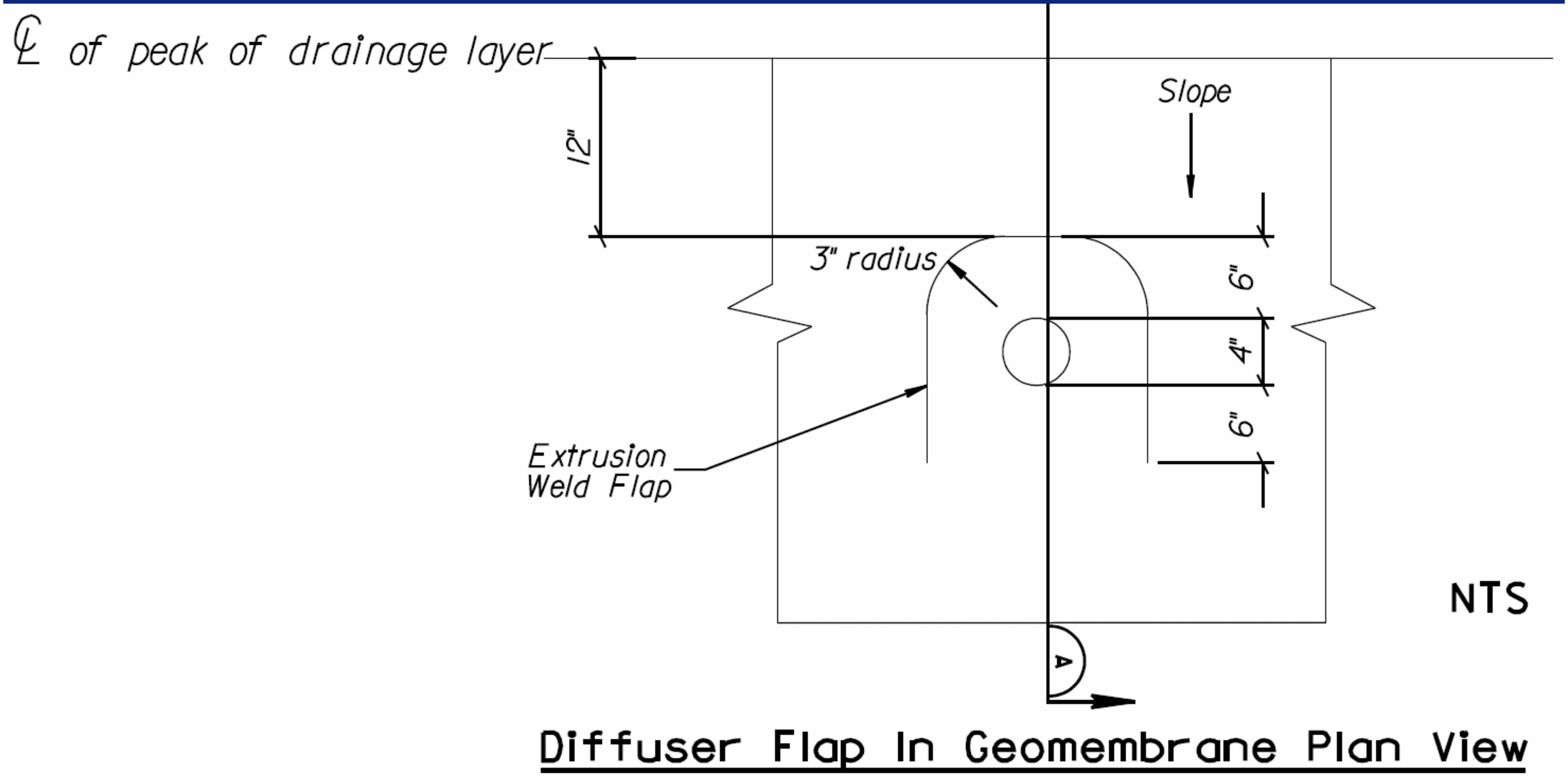
Gas Vent Locations (Internal Drainage Layer)



Gas Vent Locations (Final Reuse)



Typical Diffuser Flap Vent Detail



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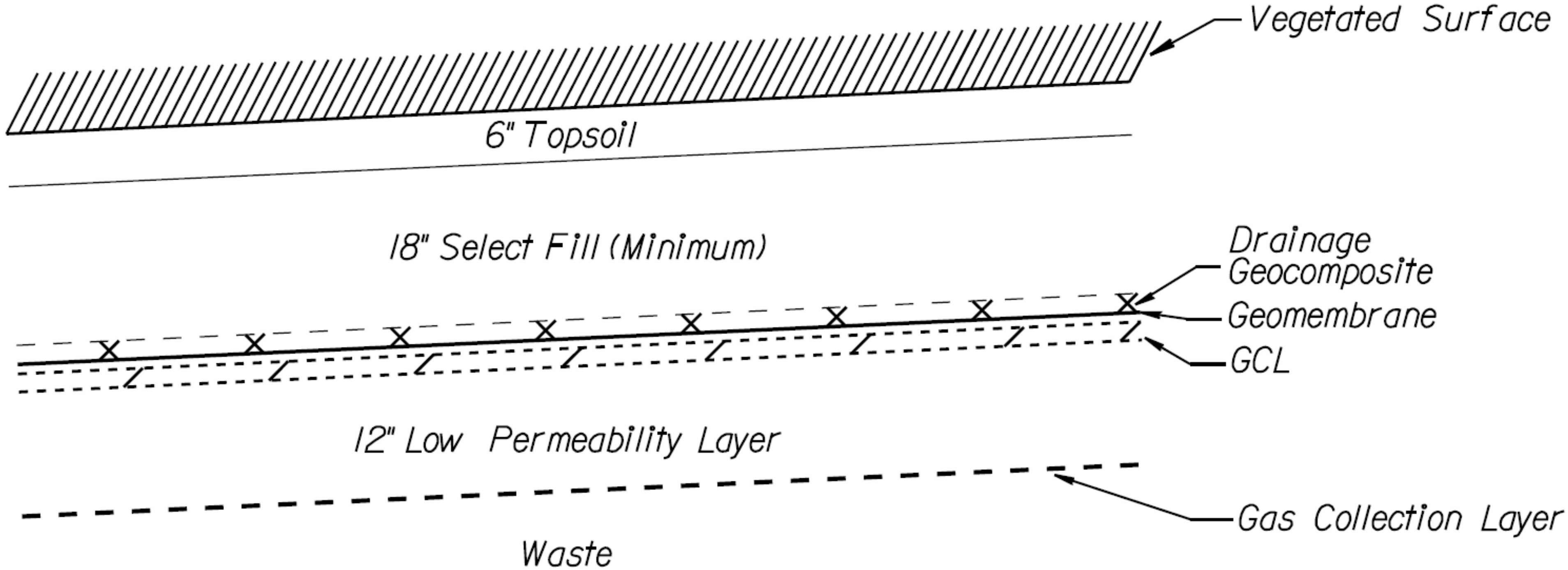
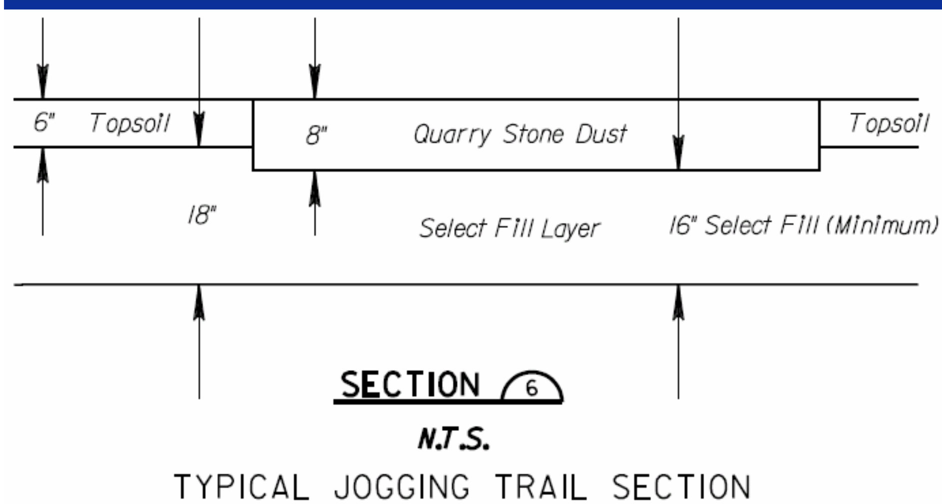
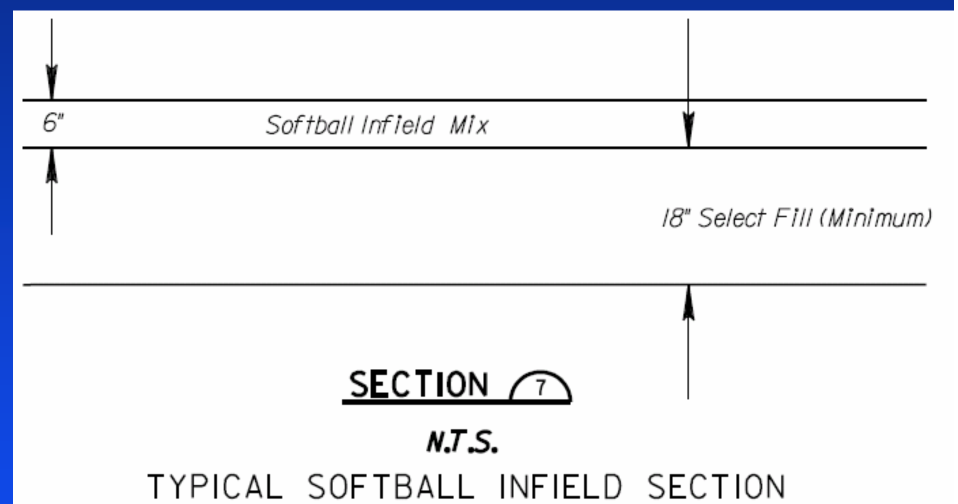
Typical Vegetated Landfill Section

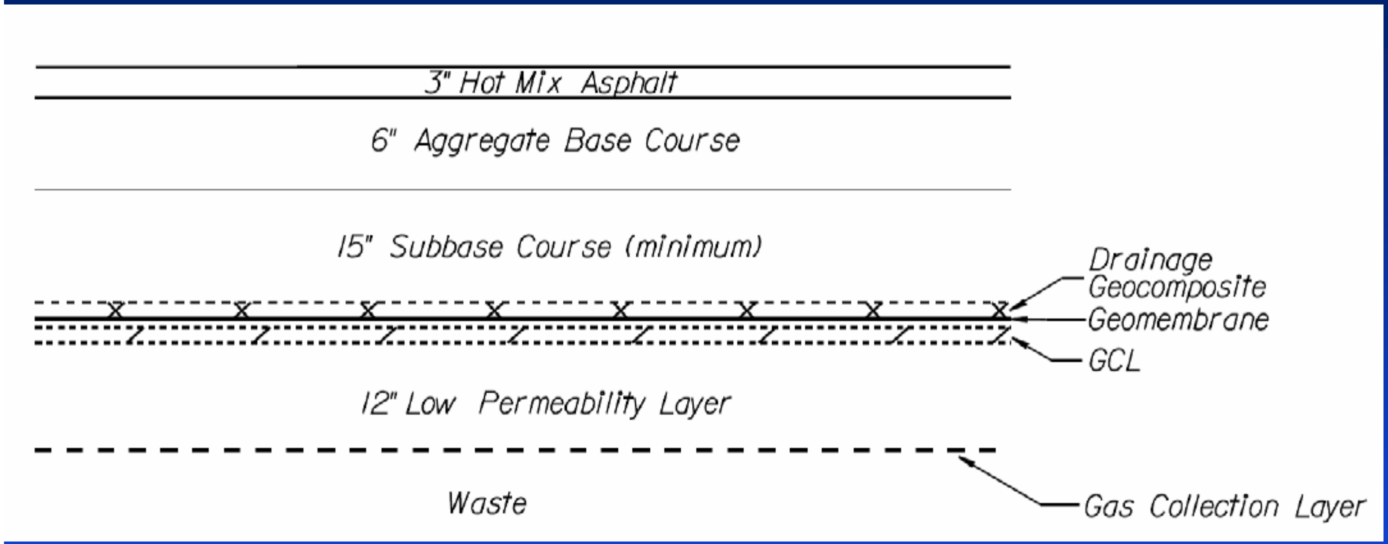


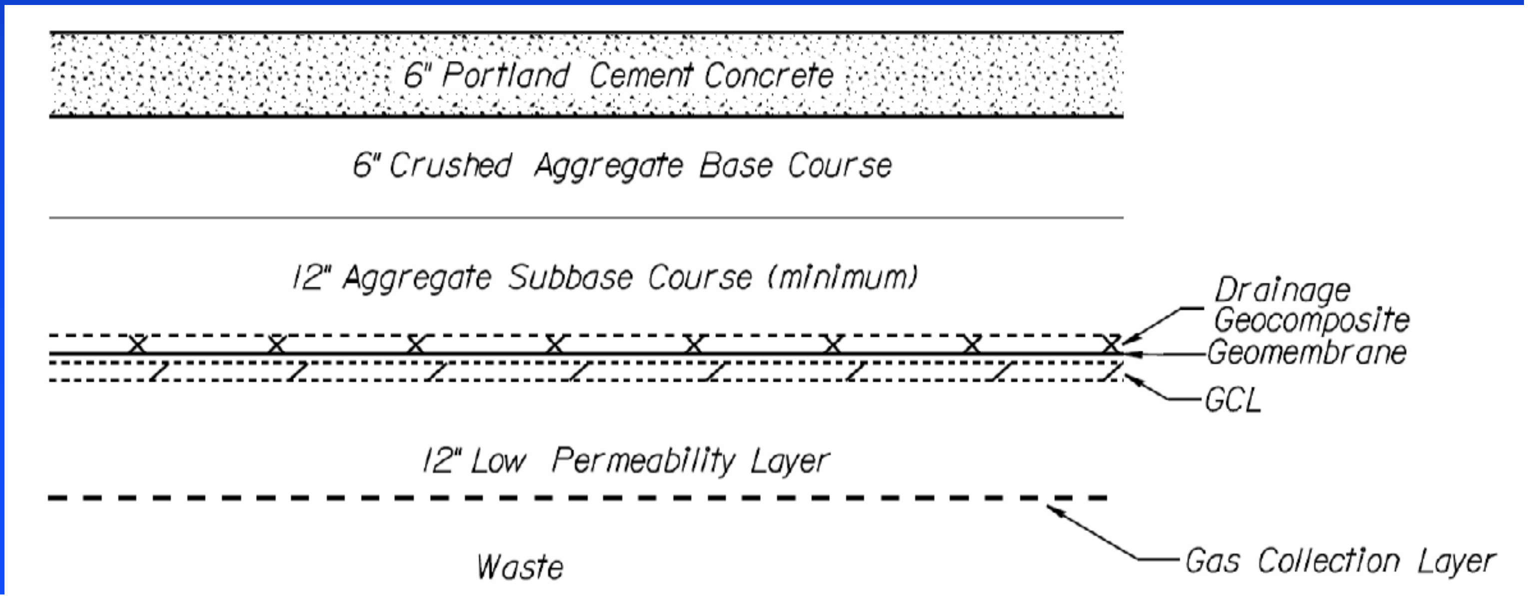
Typical Vegetated Landfill Section Variations



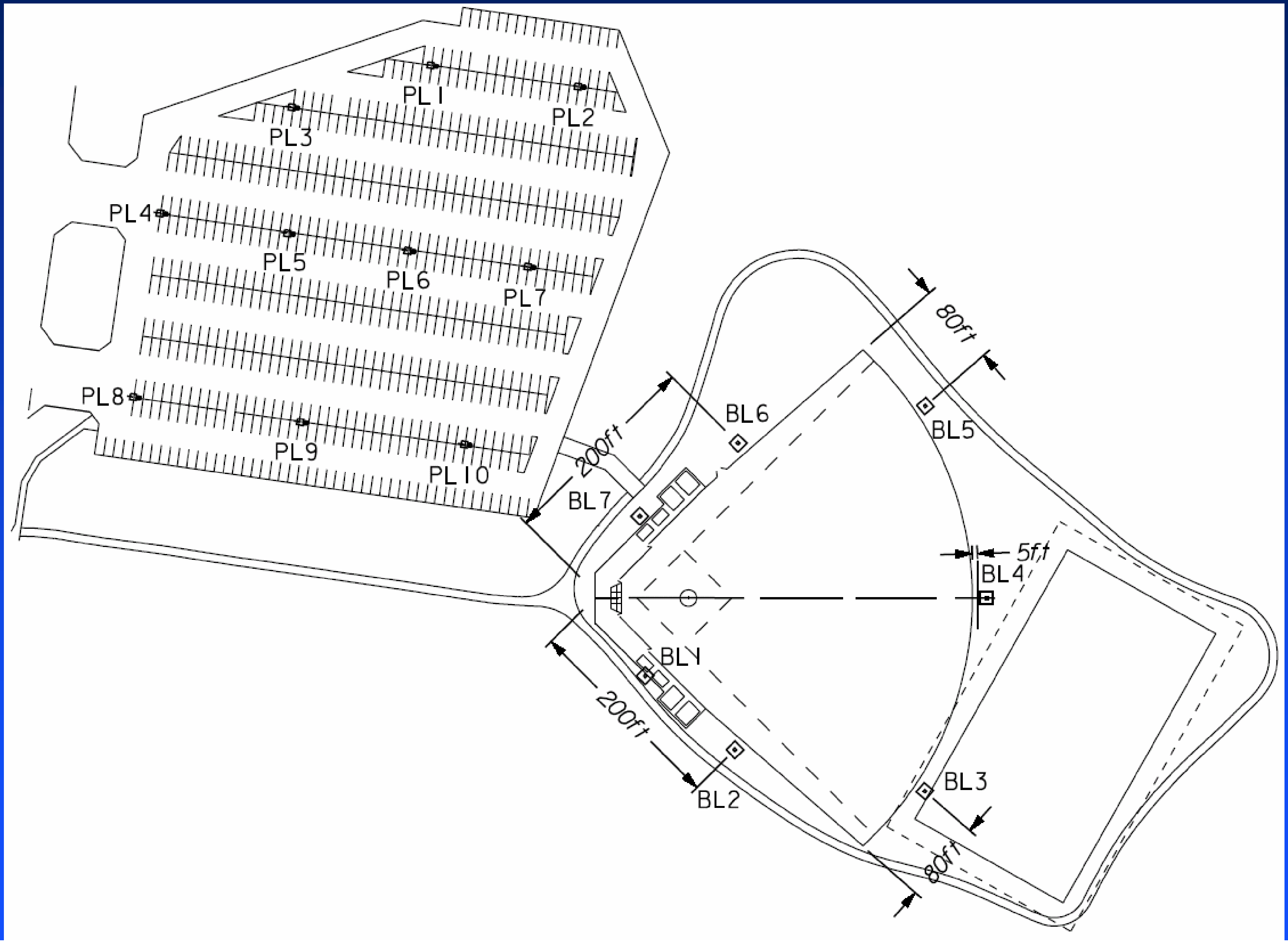


Typical Pavement Sections

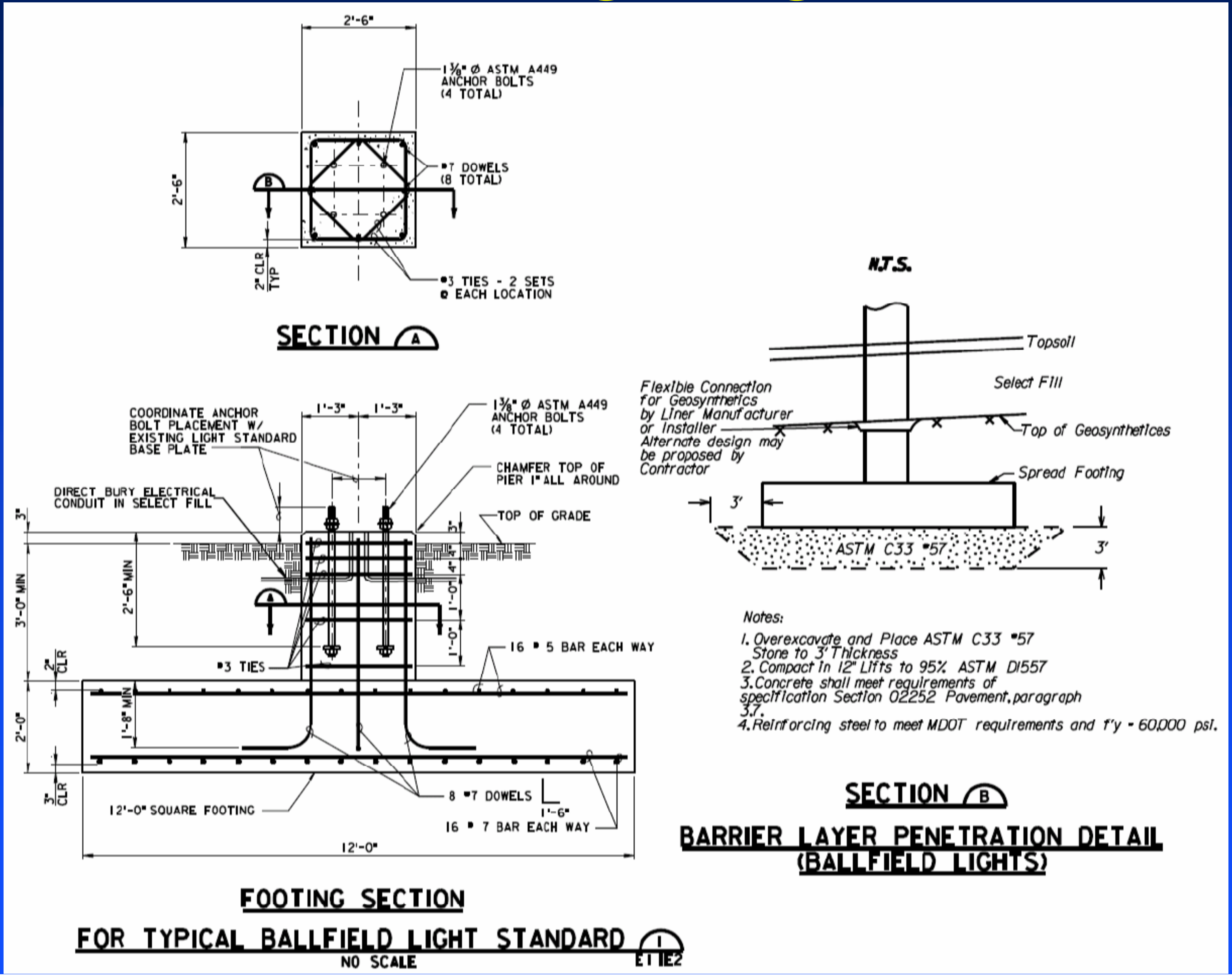




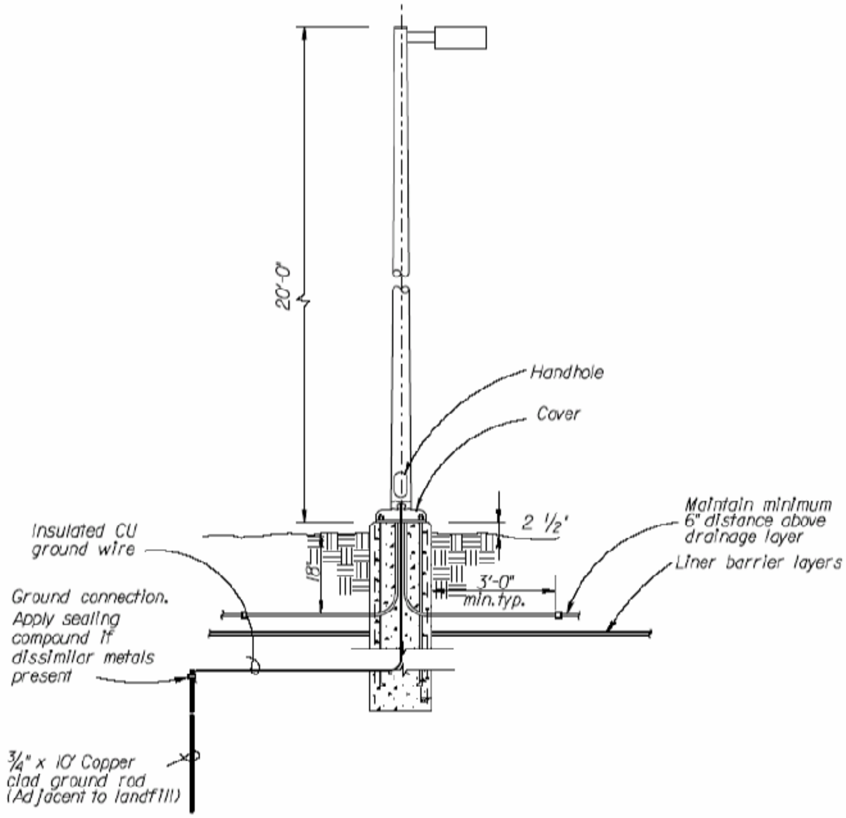
Light Pole Locations



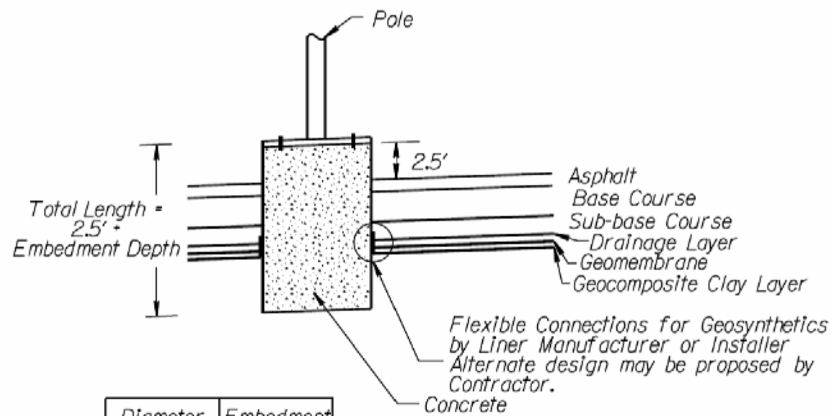
Ball Field Lighting Details



Parking Lot Lighting Foundation Details



NEW INSTALLATION DETAIL
SINGLE ARM POLE
2 E1 | E2
NO SCALE



Diameter (In)	Embedment Depth (ft)
24	6.5
30	6.0
36	5.5

Notes:

1. Contractor may choose pier footing diameter, and install with indicated embedment depth.
2. Concrete shall meet requirements of specification Section 02252 Pavement, paragraph 3.7.
3. Reinforcing steel to meet MDOT requirements and f'y = 60,000 psi.

PARKING LOT LIGHTS FOUNDATION DETAILS 3 E1 | E2
NO SCALE

Running Track, Ball Field and Lights

Asphalt Parking Lot, Lights, and Jamaica Cove Wetland

Aerial View Before Construction

Aerial View of Completed JILF

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